RFID technology applied to the glacial environment: MALATRA electronic system design and experimental data

TITLE

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The higher mountains of the Alps focus in the western part of Europe and favor a high concentration of glaciers in this area. The Aosta Valley region is surrounded by mountains, more than the 50% of its territory lying above 2000 m a.s.l. In the summer, most of the water supply of the region relies on the contribution given by snowmelt and, partially, by ice melt. Study of glacial processes is thus very important in this region. In this context the MALATRÀ project (led by Fondazione Montagna Sicura and Envisens Technologies) is created to develop a low-cost instrumentation capable of measuring with continuity the physical parameters of snow and ice. The instrumentation consists of a miniaturized electronic device (tag) equipped with sensors and placed inside an ovoidal small-dimension (48 mm diameter and 180 mm length) plastic capsule. Moreover, the implementation of radio frequency identification technology (RFID) allows remote communication from the surface with the tags placed deep into the glacier, thus saving time, effort and cost in collecting data. Tags allow communication at long distance working at 315 MHz frequency. At this step, the goal is to use such devices during the annual glaciological campaigns to measure the weight of the snowpack above the tag (with a pressure sensor), in order to derive the snow water equivalent (SWE) and temperature inside the ice. As a first step, the capsules will be coupled with ablation stakes installed in the ice, placed at the bottom of boreholes. Each capsule is uniquely identified by a code and can be located in a 3-D local system via radio using a localization algorithm under development. It is then, during the installation, georeferenced absolutely using a GNSS receiver. This functionality also allows for the glacier displacement measurements. Once the device has been identified, all the data stored in the internal memory can be remotely downloaded from the reader. At the current development stage the board is equipped with a precise thermometer (PT1000) and a pressure sensor to catch ice data, a magnetometer and a tri-axial accelerometer sensor to study the movement of the capsule within the ice. The performance of the system has been tested in the glacial environment with excellent results.

Keywords: RFID, electronic board, glacier monitoring, SWE, sensors, mass balance, localisation algorithm